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GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: 9/1/77

Project Title: Monitoring Radionuclide Content of Community Drinking Water Supplies

Project No: B-10-649

Project Director: Bernd Kahn

Sponsor: Environmental Protection Division; Ga. Dept. of Natural Resources

Agreement Period: From 4/15/77 Until 12/31/77

Type Agreement: Contract dated 4/15/77

Amount: $9,925

Reports Required: Monthly Progress Reports; Quarterly Progress Reports

Sponsor Contact Person (s):

Technical Matters

Contractual Matters
(thru OCA)

Steve Ivey
Management Analyst
Environmental Protection Division
Georgia Department of Natural Resources
270 Washington Street, S.W.
Atlanta, Ga. 30334

Defense Priority Rating:

Assigned to: OIP (School/Laboratory)

COPIES TO:

Project Director
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Accounting Office
Procurement Office
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Library, Technical Reports Section
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Director, Physical Plant
EES Information Office
Project File (OCA)
Project Code (GTRI)
Other

CA-3 (3/76)

no action ocg

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: 4/11/78

Project Title: Monitoring Radionuclide Content of Community Drinking Water Supplies

Project No: B-10-649

Project Director: Dr. Bernd Kahn

Sponsor: Georgia Department of Natural Resources, Environmental Protection Division

Effective Termination Date: 12/31/77

Clearance of Accounting Charges: 12/31/77

Grant/Contract Closeout Actions Remaining:

X Final Invoice ~~and Closing Documents~~

_ Final Fiscal Report

_ Final Report of Inventions

_ Govt. Property Inventory & Related Certificate

_ Classified Material Certificate

_ Other ______

NOTE: CONTINUED BY B-10-654

Assigned to: OIP/ERC (School/Laboratory)

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Procurement Office	Project Code (GTRI)
Security Coordinator (OCA)	Other ______
Reports Coordinator (OCA)	

CA-4 (3/76)

Quarterly No 2 B10-649

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF INTERDISCIPLINARY PROGRAMS
205 OLD CIVIL ENGINEERING BUILDING
ATLANTA, GEORGIA 30332

ENVIRONMENTAL RESOURCES CENTER
(404) 894-2375

BIOENGINEERING CENTER
(404) 894-2375

October 17, 1977

MEMORANDUM

TO: Mr. James Setser, Branch Chief for Program Coordination, EPD, DNR

FROM: Bernd Kahn, Director *Bernd*
Environmental Resources Center

SUBJECT: Quarterly Report of Activities for the State by the Environmental Radiation Laboratory, July 1 - September 30, 1977

Laboratory Activities

Calibration of thermoluminescent dosimeters (TLD's) was continued and TLD's exposed at nuclear facilities were read. Radioactivity standards were used to calibrate the NaI(Tl) and liquid scintillation detectors. Fallout from a new Chinese atmospheric nuclear test was monitored by measuring the radionuclide content of air filters by gross beta counting and by spectrometry with a Ge(Li) detector, and of rainwater by spectrometry. The most important methods for monitoring the radionuclide content of public water supplies have been given initial tests. Instruments for alpha-beta particle detection and radon alpha particle detection were received, and are in the process of being placed into operation. The new wet laboratory is on the verge of completion.

The LiF TLD's used in routine operation as well as more sensitive CaF_2:Dy TLD's were exposed for approximately 600 hours at three locations northwest of Atlanta over undisturbed soil at a height of 1 meter to calibrate them for response to environmental conditions. Twenty dosimeters of each type were exposed in sets of five at each location, one-half of them in plastic cards and the other half in thin black plastic sleeves. The ambient gamma radiation background was measured with a pressurized ionization chamber (PIC) that was located at each of the three locations for at least three 24-hour periods during the exposures. The PIC had been calibrated with a 10-mg Ra-226 source; it read 11 percent higher than computed from the inverse square law and correction for gamma-ray absorption in air. The following calibrations were obtained on the basis of the PIC readings, corrected for the calibration value:

with variable windows to select optimum energy ranges for both high counting efficiency and high senstivity.

Samples of collected rain water and air filters were analyzed by Ge(Li) spectroscopy for traces of fallout from the mainland Chinese atmospheric nuclear test on September 17, 1977. The air filters collected until the morning of September 23, 1977 showed no fresh fallout (less than 2 femtocurie of I-131 or Ba-140 per m^3). Fresh fallout was found in the air sample collected for the period September 23-26, 1977, and in rain collected on September 25, 1977--the first rain since September 21. Subsequently collected air filters were sent directly to the U.S. EPA laboratory and were therefore not analyzed, but two subsequent rains also showed fresh fallout. All of these samples contained recently formed Zr-95, Nb-95, Mo-99, Ru-103, I-131, Te-132, Ba-140, Ce-141, Nd-147, and Np-239, as well as Ru-106, Cs-137, and Ce-144 from former tests and naturally occurring Be-7, Pb-214 plus progeny, and Pb-212 plus progeny.

The concentration procedure for gross alpha and beta counting of community drinking water supply samples and the Ra-226 plus Ra-228 procedure for these samples were tested with tap water both to train the laboratory staff and to check for analytical problems. These methods are believed ready for use, but the radiation detection instruments are not yet available. Both the automatic sample-changer alpha-beta detector and the three ZnS detectors for Rn-222 were recently delivered, but need to be made operable.

During the next quarter, the following activities are planned:

1. Moving into the new laboratory.
2. Placing the automatic sample-changer low-level alpha and beta counter and the Rn-222 counters into operation;
3. Continuing the calibration of the liquid scintillation counters and NaI(Tl) detector with spectrometer, and beginning calibration of the alpha/beta and Rn-222 detectors;
4. Testing the gross-activity and radium analyses for drinking water; and
5. Beginning analyses of selected water-supply samples for these radionuclides.

Administrative Activities

Three contracts were processed for operating the laboratory for State EPD activities:

- B-10-646 provides technical laboratory services for environmental radionuclide measurements;
- B-10-648 provides laboratory supervision; and
- B-10-649 provides analytical services for samples collected under the Safe Drinking Water Act.

Ms. Catherine Card was employed as Chemistry Technician on July 1, 1977.

Ms. Patricia Moore was assigned to the laboratory under the CETA program on September 12, 1977.

Quarterly No. 2 B10-649

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BIOENGINEERING CENTER
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January 17, 1978

MEMORANDUM

TO: Mr. William Cline, Program Manager
Environmental Radiation Program, EPD, DNR

FROM: Bernd Kahn, Director Bernd Kahn
Environmental Resources Center

SUBJECT: Quarterly Report of Activities for the State by the Environmental Radiation Laboratory, October 1 - December 31, 1977

Laboratory Activities

The low-level radioanalytical laboratory was placed into operation, and radiochemical analyses were begun for the first quarterly samples collected in accord with the Georgia Safe Drinking Water Act of 1977. Training the staff in using these methods, methods testing, and calibration of radiation detection instruments continued from the preceding quarter. The laboratory was inspected by the U.S. EPA Quality Assurance Branch (Las Vegas Laboratory), and arrangements were made to begin participation in the EPA quality assurance program by analyzing intercomparison samples on a regular schedule.

Construction of the low-level wet laboratory in the Old Civil Engineering Building was completed in December after considerable delay by the contractor. Equipment and supplies were moved in, and the laboratory is now in routine use for environmental samples. A second, smaller, laboratory in the Emerson Building is used for preparing radioactivity standards and for tracer studies.

The first 200 public water supply samples have been measured for gross alpha and beta activity. An additional 200 samples from the total of approximately 2,500 supplies, that will be analyzed have been received and acidified. An attempt has been made to give priority in analysis to those ground-water sampling locations that may have high radium content on the basis of geological structure. Guidance for this selection was obtained from Mr. Sam Pickering, Director, Geologic and Water Resources Division. The following areas were considered to be possible sources of radium in water:

1) Monazite sands in extreme southeast Georgia;
2) Phosphate deposits in the costal plain;
3) Cretaceous sands along the Fall Line;

SKB

The first tritium and gamma-ray spectroscopy samples have been received and are being processed.

Participation in the 1977 TLD intercomparison program showed that the previously obtained calibrations of thermoluminescent LiF dosimeters yielded results for field exposures that were 12 percent highter than the expected values while those for laboratory exposures were 30 percent low, as shown in Table 2. The field exposure was at low levels for an extended period, while the laboratory exposure was a higher value for a brief period. The CaF_2 dosimeters, which are not used here for field measurements but are useful for brief exposure measurements because of their greater sensitivity than LiF dosimeters, showed the same low value for the laboratory exposure; the field exposure value was within 5 percent of the average of reported values, but far higher than the expected value. The operators of the intercomparison program attribute this consistently high value to over-response to low-energy gamma rays in the region of 50-100 keV, of which there were many in the exposure field. As a result of this intercomparison, the LiF calibration value has been adjusted to 87 mR/nanocoulomb for field measurements. Calibration studies to confirm this value will be undertaken.

On two occasions, tritium samples submitted by DHR staff in connection with surveys of commercial preparation of luminous watch dials were analyzed and the results given DRH staff.

During the next quarter, the following activities are planned:

1. Completing, calibrating, and placing into routine operation the apparatus for determining radium-226 by emanation;

2. A second calibration of the Ge(Li) detector with the recently distributed NBS multi-gamma-ray standard solution;

3. Calibration of the liquid scintillation counter for Sr/Y-90, and completing the calibration of the alpha-beta gos-flow proportional counter once it is in satisfactory operation;

4. Continuing gross alpha/beta measurements of water supply samples and initiating radium analyses of samples that show high gross alpha and beta concentrations;

Field Activities

A program of environmental radiological monitoring at nuclear facilities in Georgia was discussed with Mr. Bill Cline. Arrangements were made to develop such a program during next quarter by participating in a meeting with Plant Hatch staff on January 18th and with U.S. NRC staff on February 8. Direct measurements with a pressurized ionization chamber of dose rates at TLD locations near Plant Hatch are planned in order to confirm the annual doses measured with the TLD's.

Mr. Roland Phillips assisted DHR staff in an inspection of Luminous Processes Inc. for tritium exposure, and in an inspection of a shipment of waste radioactive material.

TABLE 2

1977 Thermoluminescent Dosimeter Intercomparison

		Laboratory Exposures mR	Field Exposures mR
Expected value		91.7 ± 7.3*	34.9 ± 2.4**
Average† except for a & b		86.2 ± 12.0	31.5 ± 6.5
a. Film dosimeters in field		---	59.8 ± 16.7
b. Ca dosimeters in field		---	58.0 ± 13.2
This laboratory:	LiF	64 ± 8	39 ± 4.
	CaF_2	64 ± 7	61 ± 7.

* Calculated by intercomparison organizers

** Continuously measured with PIC by intercomparison organizers

† Except one outlier

Note: ± values are standard deviations; all values are from intercomparison report.

Final Data Submission
B-10-649

GEORGIA INSTITUTE OF TECHNOLOGY
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ENVIRONMENTAL RESOURCES CENTER
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BIOENGINEERING CENTER
(404) 894-2375

March 1, 1978

TO: Mr. William Cline, Program Manager
Environmental Radiation Program
Environmental Protection Division
Georgia Department of Natural Resources

FROM: Bernd Kahn, Director Bernd Kahn
Environmental Resources Center

SUBJECT: Radioactivity Content in Community Water Supplies Collected in Accord with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5-.28/.31

Gross alpha and gross beta activity values for the first 200 quarterly samples of community water supplies are enclosed. These were analyzed to test the analytical system, including method, analysts, detectors, and utility of the data. The samples were collected from ground-water supplies in areas of potentially high radium levels so that the results could also be examined for a pattern of elevated radium concentrations in ground water associated with known geological formations. They will also be analyzed repeatedly to test the reliability of stored samples. Analyses to provide information under the Georgia Safe Drinking Water Act of 1977 will be performed on composites of four quarterly samples, to which the samples analyzed here will contribute one-fourth of the volume.

The analyzed samples are 200-ml aliquots evaporated onto a 20-cm^2 steel planchet and counted 20 min. each for gross alpha and gross beta activity. The dried samples are weighed to correct for self-absorption of radiation, an increasing function of sample thickness for which the U.S. EPA has provided correction factors. The alpha-particle count rate is measured with a thin-end-window gas-flow proportional counter at a voltage so low that no beta particles are detected. The beta-particle count rate is measured at a higher voltage, where pulse-height discrimination reduces the alpha-particle count rate to a fraction of the value at the lower voltage without discrimination. This fraction was determined to be 14 percent with Pu-239 samples spread on the planchet, and is subtracted from the beta count rate. Measured background count rates, typically 0.04 count/minute for alpha and 1.5 count/minute for beta, are subtracted from the measured count rates to obtain the net count rate. Counting efficiency values of 0.25 and 0.50 count/disintegration were determined for alpha particles with Pu-239 and for beta particles with Cs-137, respectively. These efficiences will be checked and refined with additional standard solutions.

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The samples are usually prepared and counted in sets of 20. A duplicate is prepared for each fifth sample, and a blank after every tenth. If the weight of the sample exceeded 100 mg (5 mg/cm^2), a 100-ml aliquot was prepared and counted instead of the 200-ml sample, for a 100-min. period. The count rates were converted to values of picocurie/liter (pCi/l) and values of twice the standard deviation (2σ) of counting were computed from the gross count rates and average background count rates. If the concentration plus 2σ exceeded 5 pCi/l, a second sample was prepared, and the original and duplicate were counted 50 min. each to decrease the 2-σ value. All duplicate analyses were averaged. The resulting concentrations are shown in Table 1.

Analytical System

Preparation of a set of 20 gross activity samples for counting required approximately 4 hours. Counting these 20 samples plus 4 duplicates, 2 standards, and 3 blanks at 20 min. for alpha and 20 min. for beta requires 20 hours. The 200 samples included 5 with high solids that had to be prepared at one-half volume and counted for 100 minutes, and 23 with potential or actual concentrations above 5 pCi/l that were measured in duplicate for 50 minutes. These 28 samples require an additional 6 hours for preparation and (including 4 blanks and 2 standards) 114 hours to count; this adds 0.6 hours for preparation and 11½ hours for counting to the average time for a set of 20 samples. Additional time is needed approximately as follows per set of 20 samples: laboratory preparation, sample storage, and standards preparation, 1½ hour; counting instrument handling and maintenance, sample manipulation and data collection, 1 hour; data recording and initial evaluation, 1 hour; final data preparation and evaluation, 4 hours. Thus, the total labor for a set of 20 samples is estimated to be 12 hours, i.e. 188 person-days per anticipated 2,500 samples. The total counting time is 31½ hours per set of 20 samples, or 3,940 hours per 2,500 samples.

The 20-min. counting periods for alpha and beta appear to be useful for screening samples that have near-zero radioactivity levels; as shown in Table 1, 2-σ values at these levels are 1 or 2 pCi/l for alpha and 3 or 4 pCi/l for beta. At alpha values from 3 to 10 pCi/l, the larger 2-σ values require longer counting periods to identify clearly those samples that exceed 5 pCi/l. Ten percent of all samples were in that category. With this added effort, only 3 ambiguous samples (6 ± 2, 5 ± 1 pCi/l) remained among 200.

If the requirement to select samples containing above 2 pCi/l of gross alpha were widely invoked for localities that contained Ra-228 in drinking water, the 20-min. counts obviously would not be sufficiently precise, and considerably longer counts (i.e., for 100 minutes) or greater sample volumes would be necessary. Approximately 30 percent of the 200-ml samples weighed above 50 mg, hence doubling the sample volume for improved precision is not broadly applicable within the 100-mg weight limit. To save counting time, it should be possible to eliminate beta counting all samples except those that are high in alpha activity, from surface water supplies, and specifically designated for such analyses.

The 2-σ value of counting appears to be a reasonable estimate of the uncertainty of the gross activity, as indicated by the duplicate results listed in Table 2, although most activities were below the limits of detection. In sample #70 the activity was significantly larger than the uncertainty and the duplicates agreed within the computed limits. In no case did duplicates differ by as much as the sum of their 2-σ values.

Elevated Alpha Activity

Of 200 well-water samples from areas selected for potential high radium content in water, only 9 showed potential alpha activity levels above 5 pCi/1. These, together with some control samples, will be analyzed for radium content within the next three months to identify the alpha-emitting radionuclides and to test the analytical method. It will be of interest to obtain additional information concerning the water supplies listed in Table 3 with regard to well depth and casing, and water treatment. Most of these supplies are in the Piedmont region, 15-45 mi SW of the Savannah River, but insufficient data have been collected to define specific areas as high in gross alpha activity. A second set of 200 well-water samples is now being analyzed to attempt a better definition of such areas.

Table 1

RADIOACTIVITY CONTENT IN
GEORGIA COMMUNITY WATER SUPPLIES:
First 200 Quarterly Samples

Laboratory No.	Supply I.D.	Collection Date	Gross Activity ± 2σ[a] alpha	beta
1	312110729	092177	0 ± 2	10 ± 5
2	303603630	092177	0 ± 2	1 ± 4
3	309008774	092177	0 ± 1	7 ± 5
4	307307280	092177	0 ± 1	0 ± 3
5(b)	315713598	092177	0 ± 2	4 ± 4
6	301701307	092677	0 ± 1	0 ± 3
7	309709475	092677	0 ± 1	2 ± 4
8	314913155	092677	0 ± 1	1 ± 4
9	309909576	092877	0 ± 1	3 ± 4
10(b)	314112299	092877	0 ± 1	4 ± 4
11	302802823	100577	0 ± 1	1 ± 4
12	300800308	100577	1 ± 2	0 ± 3
13	300800292	100577	0 ± 1	2 ± 4
14	302802902	100577	0 ± 1	3 ± 4
15(b)	302802805	100577	0 ± 1	1 ± 4
16	307507433	101377	0 ± 1	2 ± 4
17	307507415	101377	0 ± 1	2 ± 4
18	305605173	101477	0 ± 1	2 ± 4
19	306005961	101477	0 ± 1	1 ± 4
20(b)	306006025	101477	0 ± 1	2 ± 3
21	307107161	101777	0 ± 1	3 ± 4
22	307114578	101777	0 ± 1	4 ± 4
23	307107152	101777	0 ± 1	2 ± 4
24	304804630	102077	0 ± 1	5 ± 4
25(b)	304804649	101977	0 ± 1	3 ± 4
26	306806784	102677	0 ± 1	2 ± 4
27	306806775	102677	0 ± 1	2 ± 4
28	306806872	102677	0 ± 1	1 ± 4
29	307107143	102577	0 ± 1	2 ± 4
30(b)	306907076	102777	0 ± 1	4 ± 4
31	315413384	102777	0 ± 1	3 ± 4
32	309108799	110177	0 ± 2	0 ± 4
33	313211643	110277	0 ± 1	4 ± 4
34	310710123	110177	0 ± 1	5 ± 4
35(b)	310709990	110177	0 ± 1	2 ± 4
36	300900457	102777	1 ± 2	0 ± 4
37	303803838	110277	0 ± 1	0 ± 4
38	406911038	110277	0 ± 1	4 ± 4
39(b)	300600207	110177	2 ± 1	7 ± 2
40(b)	304304167	102777	0 ± 1	0 ± 4

Laboratory No.	Supply I.D.	Collection Date	Gross Activity ± 2σ alpha	beta
41(b)	312210984	110177	6 ± 2(c)	11 ± 2
42	306906921	110277	0 ± 1	5 ± 4
43	306806757	110277	0 ± 1	5 ± 4
44(b)	310910206	110277	36 ± 6(c)	37 ± 4
45(b)	306606568	110277	2 ± 1	2 ± 2
46	300800283	110177	0 ± 2	1 ± 4
47	306606595	110277	0 ± 1	3 ± 4
48	(d)	110377	1 ± 2	6 ± 4
49(b)	306606586	110277	10 ± 2(c)	10 ± 2
50(b)	306006007	110477	0 ± 1	4 ± 3
51(b)	310910190	110277	8 ± 2(c)	13 ± 2
52	403806278	110377	0 ± 1	4 ± 3
53	303814104	110377	0 ± 1	5 ± 3
54(b)	311410444	110277	16 ± 3(c)	30 ± 3
55(b)	311410435	110277	1 ± 2	6 ± 4
56	303803971	110377	0 ± 1	6 ± 3
57(b)	302001550	110477	0 ± 1	0 ± 2
58	307607643	110877	0 ± 1	3 ± 3
59	307607528	110877	0 ± 1	2 ± 3
60(b)	315313378	110877	2 ± 3	7 ± 4
61	313211634	110877	0 ± 2	0 ± 3
62	307607591	110877	2 ± 2	1 ± 3
63	314312497	110877	0 ± 2	2 ± 4
64	308708248	110877	0 ± 2	1 ± 3
65(b)	302916283	111077	2 ± 2	2 ± 3
66	402938707	111077	0 ± 1	0 ± 3
67	313511848	110177	0 ± 1	4 ± 4
68	313511857	110177	0 ± 2	4 ± 4
69	301901523	110377	0 ± 2	1 ± 3
70(b)	302915846	111077	20 ± 3(c)	20 ± 2
71	(d)	110877	0 ± 1	5 ± 3
72	300800441	110877	0 ± 1	3 ± 3
73	(d)	110877	1 ± 2	2 ± 3
74(b)	307407366	110777	3 ± 2	4 ± 2
75(b)	412620890	110877	1 ± 1	3 ± 3
76	302804507	110777	0 ± 2	4 ± 3
77(b)	305905785	110877	6 ± 2(c)	9 ± 2
78	302802814	110877	0 ± 1	1 ± 3
79	302816523	110877	0 ± 1	4 ± 3
80(b)	305905776	110877	0 ± 1	4 ± 4
81	301901505	110377	0 ± 2	3 ± 4
82	301901499	110377	0 ± 2	1 ± 4
83	305705268	110877	0 ± 1	4 ± 4
84	306916869	110877	0 ± 1	0 ± 3
85(b)	305705277	110877	0 ± 2	0 ± 3
86	(d)	110977	1 ± 2	5 ± 3
87	301100658	110977	0 ± 1	0 ± 3
88	301113902	110977	1 ± 2	1 ± 3
89(b)	309809506	111477	1 ± 1	1 ± 2
90(b)	307607634	110977	4 ± 1	2 ± 2

Laboratory No.	Supply I.D.	Collection Date	Gross Activity ± 2σ alpha	beta
91	301100667	110977	0 ± 1	0 ± 3
92	301100676	110977	2 ± 2	2 ± 3
93(b)	309509408	111477	5 ± 1(c)	8 ± 2
94(b)	314515940	111477	1 ± 1	3 ± 2
95(b)	307907909	111077	1 ± 2	4 ± 4
96	314512710	111477	0 ± 1	0 ± 3
97	309509392	111477	0 ± 1	1 ± 3
98	307614722	110977	0 ± 1	0 ± 3
99	300500176	111077	0 ± 1	0 ± 3
100(b)	313211670	111577	1 ± 2	1 ± 4
101(b)	302401822	111077	0 ± 1	0 ± 2
102	315113286	111077	1 ± 3	6 ± 4
103	311210343	111777	1 ± 2	1 ± 3
104	311210370	111777	1 ± 2	3 ± 3
105(b)	306306327	110977	0 ± 2	1 ± 4
106	313211652	110977	1 ± 2	3 ± 4
107	301801438	111677	0 ± 1	2 ± 3
108	301801395	111677	0 ± 1	4 ± 4
109	307814586	111777	2 ± 1	1 ± 2
110(b)	(d)	111777	1 ± 2	2 ± 3
111	305505103	111777	0 ± 1	1 ± 3
112	306106086	111777	0 ± 1	0 ± 3
113	314412591	111677	0 ± 1	1 ± 3
114	310810166	111677	0 ± 1	1 ± 3
115(b)	313912247	111477	0 ± 1	1 ± 3
116	302702756	111477	0 ± 2	0 ± 4
117(b)	306806809	111777	2 ± 1	4 ± 2
118	300813829	111477	1 ± 2	0 ± 3
119	306806766	111577	0 ± 1	1 ± 3
120(b)	314414834	111677	1 ± 2	3 ± 3
121(b)	314913146	111677	16 ± 3(c)	23 ± 3
122	302501971	111577	0 ± 2	4 ± 4
123(b)	302501964	111577	0 ± 1	1 ± 2
124	308708266	111577	0 ± 2	5 ± 4
125(b)	312110835	111577	0 ± 1	2 ± 3
126	305304957	111677	0 ± 1	3 ± 4
127	309709466	111677	1 ± 2	1 ± 3
128	303615653	111577	0 ± 1	3 ± 3
129	312110808	111577	0 ± 1	0 ± 3
130(b)	314312488	110877	0 ± 2	2 ± 4
131	409214879	110877	1 ± 2	3 ± 4
132	315113268	110177	0 ± 2	1 ± 4
133	301601063	111777	1 ± 2	0 ± 3
134	301601081	111777	0 ± 1	2 ± 3
135(b)	411018003	112177	0 ± 1	0 ± 3
136	308508192	112177	0 ± 1	2 ± 3
137	301113887	111877	0 ± 1	1 ± 3
138	301100597	111877	0 ± 1	0 ± 3
139	305304948	111877	1 ± 2	8 ± 3
140(b)	301100579	111877	0 ± 1	1 ± 3

Laboratory No.	Supply I.D.	Collection Date	Gross Activity ± 2σ alpha	beta
141(b)	301601027	111677	0 ± 1	1 ± 2
142(b)	301100588	111877	3 ± 1	6 ± 2
143	313311695	111477	1 ± 2	0 ± 3
144(b)	312811439	111677	3 ± 1	8 ± 2
145(b)	305204899	112177	2 ± 2	4 ± 4
146	302602713	111677	1 ± 2	2 ± 3
147	302602704	111677	1 ± 2	2 ± 3
148	308508208	112177	2 ± 2	0 ± 3
149	311010224	112277	0 ± 1	2 ± 3
150(b)	311010242	112277	0 ± 1	3 ± 3
151(b)	313411762	112277	2 ± 1	2 ± 2
152	313211661	112277	2 ± 3	3 ± 4
153	413232100	112277	2 ± 2	1 ± 3
154	308708275	112277	1 ± 1	4 ± 3
155(b)	315613555	112277	0 ± 1	1 ± 3
156	310309868	111877	0 ± 1	1 ± 3
157	300500167	112277	0 ± 1	4 ± 3
158	401101463	112177	3 ± 1	4 ± 2
159	301100649	112177	0 ± 1	0 ± 2
160(b)	301100551	112177	1 ± 2	4 ± 3
161	301115120	112177	2 ± 2	8 ± 4
162	306706714	112877	2 ± 3	5 ± 4
163(b)	306706705	112877	1 ± 1	5 ± 2
164(b)	310209764	112977	1 ± 1	5 ± 2
165(b)	301801401	112977	1 ± 2	3 ± 3
166	308408177	112977	0 ± 2	8 ± 4
167(b)	312611259	112977	1 ± 1	3 ± 2
168	301100533	112977	0 ± 2	2 ± 3
169	306206153	112977	0 ± 1	2 ± 3
170(b)	306206162	112977	1 ± 2	3 ± 3
171	315013225	112377	1 ± 2	3 ± 3
172	305505121	120177	0 ± 1	6 ± 4
173	305505112	120177	0 ± 1	1 ± 3
174	405308035	112977	0 ± 1	2 ± 5
175(b)	301114242	113077	0 ± 1	0 ± 2
176	303203146	113077	0 ± 2	0 ± 3
177	308715886	113077	0 ± 1	0 ± 3
178	305304966	113077	1 ± 3	0 ± 3
179	301100560	113077	0 ± 1	2 ± 3
180(b)	301100603	113077	0 ± 1	0 ± 2
181	312110950	112877	2 ± 2	2 ± 3
182	300500158	113077	1 ± 2	3 ± 3
183	301114251	113077	1 ± 2	3 ± 3
184	312110914	112977	2 ± 2	0 ± 3
185(b)	311010233	120577	2 ± 2	5 ± 4
186	301601054	113077	0 ± 2	1 ± 4
187	308908622	120277	1 ± 2	3 ± 4
188(b)	309909585	120577	0 ± 1	2 ± 2
189	300800326	120577	1 ± 2	2 ± 3
190(b)	401602285	120177	1 ± 2	0 ± 3

Table 2

COMPARISON OF DUPLICATE ANALYSES

(200 ml volume, 20 minute counting)

Laboratory No.	Gross Activity ± 2σ, pCi/l Alpha		Beta	
5	0 ± 2	0 ± 1	6 ± 4	3 ± 4
10	0 ± 1	0 ± 1	5 ± 4	2 ± 4
15	0 ± 1	0 ± 1	1 ± 4	2 ± 4
20	0 ± 1	0 ± 1	0 ± 2	2 ± 4
25	0 ± 1	0 ± 1	3 ± 4	3 ± 4
30	0 ± 1	0 ± 2	3 ± 4	4 ± 4
35	0 ± 1	0 ± 2	3 ± 4	2 ± 4
40	0 ± 1	0 ± 1	0 ± 4	1 ± 4
45*	2 ± 2	2 ± 3	3 ± 4	2 ± 4
50	0 ± 1	0 ± 1	5 ± 3	2 ± 3
55	1 ± 2	1 ± 2	5 ± 4	6 ± 4
60	2 ± 3	1 ± 2	7 ± 4	7 ± 4
65	3 ± 3	0 ± 1	2 ± 4	1 ± 3
70*	15 ± 6	14 ± 6	20 ± 6	16 ± 5
75	1 ± 1	0 ± 2	5 ± 4	0 ± 3
80	0 ± 1	0 ± 1	6 ± 4	2 ± 3
85	0 ± 2	0 ± 2	0 ± 3	0 ± 3
90*	3 ± 3	3 ± 3	1 ± 3	3 ± 3
95	1 ± 2	1 ± 2	6 ± 4	2 ± 4
100	0 ± 2	2 ± 3	1 ± 4	1 ± 4
105	1 ± 3	0 ± 2	0 ± 4	2 ± 4
110	1 ± 2	1 ± 2	1 ± 3	2 ± 3
115	1 ± 2	0 ± 1	2 ± 3	0 ± 3
120	1 ± 2	1 ± 2	2 ± 3	3 ± 3
125	0 ± 1	0 ± 1	2 ± 3	3 ± 3
130	0 ± 2	1 ± 2	0 ± 3	5 ± 4
135	0 ± 1	0 ± 1	0 ± 3	1 ± 3
140	0 ± 1	0 ± 1	1 ± 3	1 ± 2
145	2 ± 2	2 ± 2	3 ± 3	5 ± 4
150	0 ± 1	0 ± 1	4 ± 3	2 ± 3
155	0 ± 1	0 ± 1	2 ± 3	0 ± 3
160	1 ± 2	2 ± 2	2 ± 3	6 ± 4
165	1 ± 2	1 ± 2	2 ± 3	3 ± 3
170	1 ± 2	2 ± 2	0 ± 3	6 ± 4
175	0 ± 1	0 ± 1	0 ± 2	0 ± 3
180	0 ± 1	1 ± 2	0 ± 2	1 ± 2
185	1 ± 2	3 ± 3	3 ± 4	6 ± 4
190	1 ± 2	2 ± 1	0 ± 3	1 ± 3
195	1 ± 2	1 ± 1	2 ± 2	2 ± 3
200	0 ± 1	1 ± 1	1 ± 3	2 ± 4

*Samples were reanalyzed to provide values in Table 1.

Table 3

ELEVATED GROSS ALPHA ACTIVITY

Laboratory No.	County	City
41	Rockdale	Conyers
44	Oglethorpe	Maxeys
49	Greene	White Plains
51	Oglethorpe	Lexington
54	Pike	Molena
70	Clarke	Seminole Village Mobile Homes
77	Franklin	Carnesville
93	Madison	Danielsville
121	Warren	Camak